



Langley Research Center

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**LANGLEY RESEARCH CENTER
NOISE CONTROL AND HEARING
CONSERVATION PROGRAM**

National Aeronautics and Space Administration

Responsible Office: Office of Safety and Mission Assurance

PREFACE

This Langley Research Center Procedural requirements (LPR) sets forth the policy, responsibilities, and procedures for the Langley Research Center Noise Control and Hearing Conservation Program and is a part of this Center's Safety Manual.

LAPG 2710.1, dated July 1999, is rescinded and should be destroyed.

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DISTRIBUTION:

SDL 040, SDL 043, SDL 410, SDL 411, and SDL 412 (LaRC Safety Manual Holders)
429/Office of Safety and Facility Assurance, OSMA (200 copies)

TABLE OF CONTENTS

Chapter	Page
1. INTRODUCTION	1-1
1.1 BACKGROUND	1-1
1.2 AUTHORITY AND REFERENCES.....	1-2
1.2.1 AUTHORITY.....	1-2
1.2.2 REFERENCES.....	1-2
1.3 APPLICABILITY	1-2
1.4 ISSUANCE AND CONTROL	1-3
1.5 DEFINITIONS AND TERMINOLOGY	1-3
2. RESPONSIBILITIES.....	2-1
2.1 GENERAL	2-1
2.2 NOISE CONTROL AND HEARING CONSERVATION PROGRAM OFFICER (NCHCPO)	2-1
2.3 OCCUPATIONAL HEALTH SERVICES OFFICE.....	2-2
2.4 SUPERVISORS	2-2
3. PROCEDURES	3-1
3.1 NOISE HAZARD EVALUATION	3-1
3.1.1 Hazardous Noise Areas	3-1
3.1.2 Employees Working in Hazardous Noise Areas	3-1
3.1.3 Posting of Hazardous Noise Areas or Equipment.....	3-1
3.2 ENGINEERING CONTROL MEASURES	3-1
3.3 PERSONAL HEARING PROTECTION DEVICES	3-2
3.3.1 Steady-State Noise Exposure	3-2
3.3.2 Impulse Noise Exposure.....	3-2
3.3.3 Availability of Protective Devices	3-2
3.4 MONITORING AUDIOMETRY.....	3-3
3.5 TRAINING	3-3
3.5.1 Personnel Working in Hazardous Noise Areas	3-3
3.5.2 Supervisory and Managerial Personnel	3-3
3.6 RECORDS	3-3

APPENDICES

Appendix	Page
A. ELEMENTS OF THE NASA LARC NOISE CONTROL AND HEARING CONSERVATION PROGRAM	A-1
A.1 NOISE HAZARD EVALUATION	A-1
A.1.1 Sound Level Meter.....	A-1
A.1.2 Acoustical Calibrator (Pistonphone).....	A-1
A.1.3 Annual Calibration	A-1
A.2 POSTING OF HAZARDOUS NOISE AREAS AND EQUIPMENT	A-1
A.3 PERSONAL HEARING PROTECTION DEVICES.....	A-2
A.3.1 Care of Earplugs	A-2
A.3.2 Hand-Formed Earplug Inserts (Disposable).....	A-2
A.3.3 Earmuffs	A-2
A.4 MONITORING AUDIOMETRY	A-3
A.5 RECORDS.....	A-3
B. DEFINITIONS AND TERMINOLOGY	B-1
C. ACRONYMS	C-1

Chapter 1

1. INTRODUCTION

These procedural requirements include the policy and responsibilities, which establish the NASA Langley Research Center (LaRC) Noise Control and Hearing Conservation Program (NCHCP). This chapter presents background, references and authority, and applicability of these procedural requirements. The Office of Safety and Facility Assurance (OSFA), Office of Safety and Mission Assurance (OSMA) is the LaRC contact for the NCHCP.

1.1 BACKGROUND

Every effort shall be made to ensure that the work environment affords the necessary protection and conservation of LaRC employees' hearing. Noise-induced hearing loss is a serious threat to people exposed to hazardous noise levels. Loss of hearing can occur from exposure to impulse or impact noise as well as from exposure to steady-state (continuous/intermittent) noise. The hearing loss may be temporary or may become permanent through repeated unprotected exposure to intense noise. Initial deterioration of hearing may not be apparent to the individual. By the time there is worker awareness of the loss, the impairment may be substantial and irreversible.

Hearing loss due to noise exposure is preventable. Preventive efforts shall be taken to conserve the hearing of personnel employed at LaRC by implementing a NCHCP (Chapter 3 and Appendix A).

If controls fail to reduce sound levels to within the specified limits, or during the period controls are being initiated, the remaining components of the NCHCP, as addressed in Chapter 3 and Appendix A, shall be implemented. Personal hearing protective equipment, under administrative controls (limitation of exposure duration), shall be used as warranted.

The aim of this procedure and guideline is to:

- control noise generated by LaRC operations.
- prevent occupational noise-related hearing loss among employees.
- provide a work environment free from hazardous noise.
- give priority to engineering procedures to the greatest extent practicable to eliminate, control, or isolate sources of hazardous noise.

1.2 AUTHORITY AND REFERENCES

It is LaRC policy to comply with NASA regulations and Federal Laws as prescribed in the following documents:

1.2.1 AUTHORITY

- Noise Control Act of 1972, as amended.
- "Occupational Noise Exposure," 29 Code of Federal Regulations (CFR) 1910.95.
- "Basic Program Elements for Federal Employee Occupational Safety and Health Program," 29 CFR Part 1960 (1986).
- Executive Order 12196 of February 26, 1980, "Occupational Safety and Health for Federal Employees."
- American National Standards Institute (ANSI) Standards S3.6-1969 and S1.4-1971 (R 1976).
- NASA Health Standard/Industrial Hygiene (NHS/IH) - 1845.4, "NASA Health Standard on Hearing Conservation," 1991.

1.2.2 REFERENCES

- NASA Procedural Requirements (NPR) 8715.3, "NASA Safety Manual."
- NPR 8715.1, "NASA Safety and Health Handbook Occupational Safety and Health Programs."
- Langley Policy Directive (LAPD) 1700.2, "Safety Assignments."
- LMS-CP-4760, "Reporting Injuries, Illnesses, Compensation Claims and Unsafe Working Conditions."

1.3 APPLICABILITY

These procedural requirements are applicable to all LaRC facilities. The requirements of these procedural requirements are to be incorporated in any contract under which contractor employees will be assigned to on-site LaRC high noise or potential high noise areas.

It is the responsibility of Contractors to provide and implement their own noise control and hearing conservation programs at facilities solely operated by the Contractor. As a minimum, these shall be in accordance with the LaRC programs as described herein.

The provisions of these procedural requirements, which define periodic noise hazard evaluations, personal hearing protective devices, education, audiometric testing, and personnel preselection criteria do not apply to hearing-impaired personnel.

NOTE: Excessive stretching of the tympanic membrane (eardrum) is the source of pain from high intensity noise in normal hearing individuals. Noise, which is painful to normal hearing, will also be painful to the hearing-impaired who have eardrums. Therefore, the hearing-impaired should be protected from steady-state noise over 120 dBA and

high-level impulse noise over 150 dBP sound pressure level (SPL) (Appendix B, "Definitions and Terminology") and educated accordingly. In addition, any residual hearing should be closely monitored if the hearing-impaired are exposed to high-level noise.

1.4 ISSUANCE AND CONTROL

OSFA is responsible for the issuance, distribution, and control of these procedural requirements. Revisions shall be reviewed with affected organizations and documented on a Transmittal Notice.

1.5 DEFINITIONS AND TERMINOLOGY

Appendices B, "Definitions and Terminology," and C, "Acronyms," are included to assist with using these procedural requirements.

Chapter 2

2. RESPONSIBILITIES

2.1 GENERAL

This chapter describes the responsibilities of the Noise Control and Hearing Conservation Program Officer (NCHCPO), Occupational Health Services Office (OHSO), and line management.

2.2 NOISE CONTROL AND HEARING CONSERVATION PROGRAM OFFICER (NCHCPO)

The Safety Manager is the NCHCPO and is responsible for:

- implementing and administering the NCHCP.
- ensuring that personnel who work in hazardous noise areas, including supervisors/managers, are instructed, individually or in groups, by qualified personnel concerning health hazards associated with noise exposure, noise control measures, and the NCHCP requirements.
- maintaining a current inventory of all hazardous noise areas and noise levels recorded in these areas. (The inventory shall be maintained in OSFA.)
- making recommendations on the placement or reassignment of personnel with significant hearing loss based on the suggestion of the Occupational Health Officer (OHO), Office of Human Resources (OHR), the need for additional employee training and specific limitations on exposures, and environmental monitoring, audiometric test results, and medical findings.
- measuring and analyzing noise levels to evaluate levels of employee exposures recommend appropriate means of controlling exposures found to be excessive and to achieve regulatory compliance. Potential noise exposure areas are to be identified by industrial hygiene inspections, investigation of complaints, participation in construction design reviews, and review of purchase requests, contracts, and engineering (noise abatement) drawings.
- conducting a pre-operational survey of each new operation, job, or procedure, which has an associated noise hazard potential before normal operations begin; and, identifying tools and equipment which generate excessive noise levels.
- conducting, as requested, resurveys to evaluate each hazardous noise or job area in order to maintain master lists of areas which require hearing protection.
- reviewing facility (i.e., rehabilitation) and operational plans to assure that adequate attention is being given to noise exposure controls.
- maintaining survey data relative to noise levels and employee exposures.
- selecting hearing protective devices (in conjunction with OHO) to be used and assessing the adequacy of all noise control measures.
- ensuring the procurement and stocking of personal hearing protection devices.
- conducting an annual review to ensure that employee hearing protection training is adequate.

2.3 OCCUPATIONAL HEALTH SERVICES OFFICE

The OHSO, OHR, is responsible for:

- obtaining noise histories, supervising audiometric testing in support of the NCHCP, and evaluating test results.
- maintaining a registry of personnel working in hazardous noise areas, scheduling and conducting appropriate medical examinations, and/or referring personnel to an audiologist or an appropriate medical consultant.
- notifying employees on detection of a significant hearing loss, and explaining the need and plans for further testing referrals. The employee's supervisor shall be notified if further testing substantiates a significant hearing loss. The supervisor and employee shall be notified if a change in job assignment is recommended as a result of hearing loss. This change shall be implemented in accordance with applicable personnel actions.
- ensuring that physicians have hearing conservation training and that personnel performing audiometry are certified by the Council on Accreditation for Occupational Hearing Conservation. (Persons who operate microprocessor audiometers do not need to be certified.)
- ensuring that audiometric equipment is calibrated and that ambient noise levels in the test environment permit measurements to 0 dB hearing level (ANSI S3.6-1969).
- maintaining audiometric test results and other medical records pertinent to the NCHCP.
- ensuring that hearing protectors fit properly and that they are available from the LaRC Stockroom. Hearing protectors include earplugs, disposable foam inserts, and earmuffs.

2.4 SUPERVISORS

Supervisors are responsible for:

- reporting to the NCHCPO suspected noise hazards in their functional areas.
- supplying the NCHCPO and the OHSO with the names of personnel working in designated hazardous noise areas or being exposed to hazardous noise. This is required so that the necessary training, hearing protective devices, baseline monitoring audiometric examinations, and other needed care or examinations can be provided.
- referring to the LaRC Occupational Medical Center (OMC) for examination and fitting of personal protective devices all personnel who complain of hearing loss or other hearing or ear problems.
- ensuring employees keep their appointments at the LaRC OMC for examination and fitting of hearing protective devices.
- enforcing the wearing of needed hearing protective devices to conserve hearing and ensuring that administrative controls are followed.
- advising the NCHCPO of any changes in operations requiring noise determinations or evaluations.

- assuring procurement (including credit card purchases) of personal protection and noise generating equipment by obtaining the approval of the NCHCPO.

Chapter 3**3. PROCEDURES**

The procedures for implementing the NCHCP are presented in this chapter. The procedures include noise hazard evaluation, application of engineering control measures, use of personal hearing protection devices, monitoring audiometry, training, and recordkeeping. Refer to Chapter 2 of this document for responsibilities.

3.1 NOISE HAZARD EVALUATION

Noise hazard evaluation includes identifying hazardous noise areas, registering employees working in these areas, and posting signs and decals in those areas.

3.1.1 Hazardous Noise Areas

Areas shall be identified by noise measurement as specified in Appendix A. Areas shall be resurveyed within 30 days of any modification affecting the noise levels. A walkthrough inspection shall be conducted, at least once a year, during the industrial hygiene inspection. Where significant differences from the previous year's survey are noted, the area shall be resurveyed. The results of these surveys shall be recorded by the NCHCPO. These records shall be retained for at least 40 years.

3.1.2 Employees Working in Hazardous Noise Areas

A register of employees who work in designated hazardous noise areas shall be maintained by line management officials within each LaRC facility. The dates, levels of noise, and period of employment in designated hazardous noise areas shall be recorded in these employees' medical records.

3.1.3 Posting of Hazardous Noise Areas or Equipment

All work areas or equipment which produce sound pressure levels of 85 dBA or greater, or 140 dBP sound pressure level for impulse/impact noise, shall be prominently posted with signs and decals as prescribed in Appendix A. These signs and decals are available from the NCHCPO.

3.2 ENGINEERING CONTROL MEASURES

Engineering control measures include the following:

- Effective engineering noise controls are the primary methods used to protect personnel from the hazards of noise. All practical design approaches to reduce levels by acoustical engineering should be explored and used to reduce steady state noise levels to below 85 dBA and impulse noise levels to below 140 dBP, or to the maximum extent possible. In each instance where, at the design stage, the known or suspected noise level is expected to exceed current maximum allowable limits, the cognizant project or facilities engineer shall document and forward these findings to the NCHCPO. Corrective action to abate all levels to acceptable levels shall be included.

- New equipment being considered for purchase is to have the lowest noise emission levels that are technologically and economically feasible and compatible with performance and environmental requirements. When selling their products to LaRC, vendors shall specify maximum noise levels that can be expected.
- Acoustic considerations shall be included in the criteria of plans and specifications for all new facilities, substantial modification projects for facilities, and for aircraft and spacecraft systems and subsystems. The objective is to ensure, if feasible, an A-weighted sound pressure level of less than 85 dBA at all locations in which personnel may be present during normal operations.

3.3 PERSONAL HEARING PROTECTION DEVICES

Selection of personal protection hearing devices depends on the type of noise (steady state or impulse) and personnel comfort. Appendix A presents descriptions of personal protection hearing devices.

3.3.1 Steady-State Noise Exposure

Approved personal hearing protection devices shall be issued to and used by all employees who either work in designated hazardous noise areas or with hazardous noise equipment where there are steady-state noise exposure levels of 85 dBA or greater. Earplugs or earmuffs may attenuate steady-state noise from approximately 15 dB in the lower frequencies to approximately 35 dB in the higher frequencies. Earplugs and earmuffs shall be worn when personnel work in areas where the steady-state noise levels are 110 dBA and above. This combination provides approximately 5 to 10 dB more attenuation at most frequencies. Occupancy in areas with steady-state noise levels of 120 dBA and above requires that hearing protection devices be worn in combination and that a limitation be placed on daily exposure time (administrative controls). The tradeoff rate between noise level and allowable daily exposure is five dBA for every halving of time. Personnel occupancy in areas with steady-state noise levels above 140 dBA shall be avoided regardless of the duration of exposure.

3.3.2 Impulse Noise Exposure

Measures for protecting hearing against impulse noise are the same as for steady-state noise. Protective devices shall be worn when impulse noise levels exceed 140 dBP. Earplugs and earmuffs shall be worn in areas with impulse noise in excess of 165 dBP.

3.3.3 Availability of Protective Devices

Adequate protective devices (disposable earplugs and earmuffs) shall be maintained and made available from the LaRC Stockroom.

3.4 MONITORING AUDIOMETRY

Monitoring audiometry, as specified in Appendix A, is a primary element of the NCHCP. All employees, who are exposed to a level of 85 dBA Time Weighted Average (TWA), calculated on an 8-hour day, shall be required to take pre-certification, annual and termination audiometric testing. Audiometric testing is used to identify the presence of early changes in hearing sensitivity. In combination with a history of all noise exposure, including off-duty noise exposure, monitoring audiometry makes it possible to determine if the issued hearing protection is being used and if engineering controls are adequate. It may be possible to identify individuals who are highly susceptible to noise-induced hearing loss.

3.5 TRAINING

Training is required for personnel working in, supervising, or managing hazardous noise areas.

3.5.1 Personnel Working in Hazardous Noise Areas

All personnel who routinely work in hazardous noise areas, or with hazardous noise equipment, shall be trained periodically regarding the permanent nature of noise induced hearing loss, type and use of personal protective measures, and the requirements of the NCHCP. The symptoms that may be experienced before permanent hearing loss occurs should be explained and the importance of obtaining early medical/audiologic evaluation of these symptoms should be stressed. In addition, personnel shall be encouraged to use hearing protectors whenever they are exposed to hazardous noise during off-duty activities (for example, from lawn mowers, firearms, and so forth). As designated by the NCHCPO, or other trained designees, this training shall be performed by OHSO at the time of routine personnel noise examinations.

3.5.2 Supervisory and Managerial Personnel

The NCHCPO or other trained individuals shall conduct training for supervisors and managers of personnel in hazardous noise areas emphasizing their responsibilities in the program.

3.6 RECORDS

OSFA identifies buildings with hazardous noise levels and shall furnish this information to the OHSO. During the industrial hygiene inspections of these buildings, a list of the names of the personnel in the NCHCP shall be updated and furnished to the OHSO. Records pertaining to the conduct of the NCHCP shall be maintained in accordance with Appendix A.

Appendix A**A. ELEMENTS OF THE NASA LaRC NOISE CONTROL AND HEARING CONSERVATION PROGRAM**

The basic elements of the LaRC Noise Control and Hearing Conservation Program includes noise hazard evaluation, posting of hazardous noise areas and equipment, personal hearing protection devices, and monitoring audiometry.

A.1 NOISE HAZARD EVALUATION

Noise measurements shall be made by industrial hygienists or other personnel who have been trained in noise evaluation techniques. A noise survey shall be conducted with a sound level meter to identify areas and equipment which have intensity levels of:

- 85 dBA or greater for steady and/or intermittent noise.
- 140 dB peak sound pressure or greater for impact/impulse noise.

A.1.1 Sound Level Meter

The sound level meter shall conform, as a minimum, to the requirements for a Type 2 sound level meter as specified in ANSI Standard S1.4-1971 (R 1976). Measurements shall be taken at the approximate position of the worker's more exposed ear, using the A-weighting network and slow meter response. A sufficient number of readings shall be taken to account for variations in noise levels.

A.1.2 Acoustical Calibrator (Pistonphone)

The sound level meter shall be calibrated with the acoustic calibrator, before and after noise measurements, on the day that measurements are to be made. The Industrial Hygienist using the sound level meter shall maintain a record of these daily calibrations.

A.1.3 Annual Calibration

Annually, the sound level meter and acoustic calibrator shall be comprehensively calibrated by the factory or factory equivalent. The results of these procedures shall be maintained on calibration worksheets. When the equipment is found to be out of calibration, the Noise Control and Hearing Conservation Program Officer is to be notified that corrective actions are being taken.

A.2 POSTING OF HAZARDOUS NOISE AREAS AND EQUIPMENT

Caution signs, visible to personnel entering or working in the area, shall be posted at entrances to or on the periphery of hazardous noise areas to alert workers and visitors that a noise hazard exists and that proper precautions shall be taken. Signs shall have wording in black letters on a yellow background as follows:

<p style="text-align: center;">CAUTION - NOISE AREA - MAY CAUSE HEARING LOSS - USE PROPER HEARING PROTECTION</p>

Caution decals, designed for individual pieces of equipment, shall be affixed on each tool or piece of equipment which produces hazardous noise levels. These decals shall have black lettering on a yellow background as follows:

<p style="text-align: center;">CAUTION - NOISY EQUIPMENT - MAY CAUSE HEARING LOSS - USE PROPER HEARING PROTECTION</p>
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NOTE: Exceptions may be made when an entire space is designated as a hazardous noise area and the tools/equipment are stationary.

A.3 PERSONAL HEARING PROTECTION DEVICES

Personal hearing protection devices include earplugs and earmuffs.

A.3.1 Care of Earplugs

Properly fitted earplugs will not cause damage to the normal ear canal provided the plugs are kept reasonably clean. Preformed earplugs (single and triple flange) and foam earplugs shall be cleaned with a mild soap and water solution and rinsed thoroughly. Disposable earplugs shall be destroyed after each use.

A.3.2 Hand-Formed Earplug Inserts (Disposable)

Hand-formed earplug inserts do not require medical fitting or an inventory of multiple sizes. However, employees shall be instructed how to use them. Cutting hand-formed plugs into halves is not permitted since this will result in an inadequate mass and markedly reduced noise attenuation. For hygienic reasons, hands shall be clean when preparing hand-formed earplugs for insertion.

A.3.3 Earmuffs

Earmuff requirements include:

- Type II earmuffs are designed to be worn with the suspension system over the head, in back of the head, or under the chin. Earmuffs are readily seen by supervisors. When earmuffs are used, the headband shall be properly adjusted to ensure a snug fit. When eyeglasses are worn with earmuffs, it is important that the earcup seals of the earmuffs fit well around the temples of the eyeglasses. Even a small "leak" defeats the purpose of wearing earmuffs.
- Earmuffs shall be periodically inspected for torn, punctured, or hardened seals. Damaged units must be discarded and replaced. Units issued to individuals shall be kept clean from dirt or other debris that could cause possible health problems.

A.4 MONITORING AUDIOMETRY

All monitoring audiometry shall comply with Occupational Safety and Health Act (OSHA) 29 CFR 1910.95 (g), (h), Appendices C, D, and E.

A.5 RECORDS

The OHO is to ensure that records pertaining to the NCHCP are maintained for 40 years. Records shall include as a minimum:

- noise survey data and results of special noise studies that identify and define hazardous noise areas and equipment.
- records relative to disposition of personnel for whom administrative noise controls have been recommended and those who are being carefully monitored:
 - ☐ special actions and/or recommendations which are directed at engineering controls.
 - ☐ data and information concerning the calibration and repair of sound measuring equipment and audiometers.
 - ☐ data and information on audiometric test booths, personnel hearing protectors, and auditory risk criteria.
 - ☐ data and information for use in the education program of personnel exposed in hazardous noise areas.
- records and results of all audiometric examinations and all other pertinent information shall also be maintained as a permanent part of the individual's medical record and include:
 - ☐ the audiometric test results and training performed for hearing conservation purposes.
 - ☐ an occupational noise exposure history and pertinent noise survey data and/or relevant non-occupational noise exposure.
- a current Center-wide register of personnel who routinely work in designated hazardous areas shall be kept and appropriate entries shall be made in the individual's medical record.

Appendix B**B. DEFINITIONS AND TERMINOLOGY**

Administrative Controls. Any procedure that limits daily exposure to noise by control of the work schedule.

Audiogram. A record of the threshold of audibility as a function of frequency obtained for each ear during an audiometric examination.

Audiologist. A professional specializing in the study and rehabilitation of hearing, who is certified by the American Speech, Hearing and Language Association, or licensed by a state board of examiners.

Audiometer. An electronic instrument that conforms to the requirements and specifications of ANSI Standard S3.6-1969 used for measuring hearing threshold levels.

Baseline Audiogram. The audiogram against which future audiograms are compared.

Biological Calibration Check. The audiometric testing of one or more tinnitus-free individuals, having a known stable hearing level that preferably does not exceed 25 dB at any test frequency between 500 and 6000 Hz, used for the purpose of assessing the calibration of the audiometer.

Decibel. A unit of measurement of sound level. The decibel level of a sound is related to the logarithm of the ratio of sound pressure to a reference pressure. The dB has meaning only when the reference is known. The internationally accepted reference pressure used in acoustics and at LaRC is 20 micropascals (μPa).

- **dBA (decibels - A-weighted).** A unit of measurement of sound level corrected to the A-weighted scale, as defined in ANSI S1.4-1971 (R 1976), using a reference of 20 micropascals.
- **dBp.** The unit used to express peak sound pressure level of impulse noise. The peak instantaneous pressure is expressed in decibels using a reference level of 20 micropascals.

Engineering Control. Any design procedure that reduces the sound level either at the source of the noise or within the hearing zone of the individuals.

Hazardous Noise

This noise consists of the following two types:

- **Steady-State Noise** is continuous/intermittent noise equivalent to 85 dB or greater A-weighted sound pressure level (dBA) and is considered hazardous.
- **Impulse or Impact Noise** is sound with a rise time of not more than 35 milliseconds to peak intensity and a duration of not more than 500 milliseconds to the time when the level is 30 dB below the peak. If the impulses recur at intervals of less than one-half second, they will be considered as steady-state noise. Noise equivalent to 140 dB or greater peak sound pressure level (dBP) is considered to be hazardous.

Hearing Threshold Level (HTL). The amount, in decibels, by which the threshold of audibility for an ear differs from the standard audiometric level.

Hertz (Hz). The international symbol for cycles per second. It is the unit of measurement for the frequency of tones.

Listening Checks. Preliminary checks of the audiometer, performed by the audiometric technician, to detect noise, distortion, intermittent tones, and other audiometer malfunctions which would preclude valid testing.

Monitoring Audiogram. Periodic audiometric tests, obtained subsequent to the reference audiogram, which are used to detect shifts in the individual's threshold of hearing.

Reference Audiogram. A reference audiogram is the first audiogram obtained (and available) after employment begins at LaRC. This audiogram must be obtained when the individual is free from auditory fatigue and other transient otologic pathology. (The term "reference audiogram" also applies to preplacement, preassignment, entrance, or baseline audiograms.)

Sound Pressure Level. A sound measurement expressed in decibels obtained with a sound level meter that has a flat frequency response (slow time) equivalent to twenty times the common logarithm of the ratio of the measured A-weighted sound pressure to the Standard Reference pressure of 20 micropascals (measured in decibels).

Sound Level Meter. An electronic instrument which measures sound levels conforming to the requirements for a Type II sound level meter as specified in ANSI S1.4-1971 (R 1976).

Time-Weighted Average (TWA). The constant sound level, over an 8-hour workday exposure, which results in the same noise dose as is measured.

Appendix C**C. ACRONYMS**

ANSI	American National Standards Institute
CFR	Code of Federal Regulations
HTL	Hearing Threshold Limit
IH	Industrial Hygiene
LPR	Langley Procedural Requirements
LaRC	Langley Research Center
NASA	National Aeronautics and Space Administration
NCHCP	Noise Control and Hearing Conservation Program
NCHCPO	Noise Control and Hearing Conservation Program Officer
NHB	NASA Handbook
NHS	NASA Health Standard
NPR	NASA Procedural Requirements
OHO	Occupational Health Officer
OHR	Office of Human Resources
OHSO	Occupational Health Services Office
OLM	Office of Logistics Management
OMC	Occupational Medical Center
OSMA	Office of Safety and Mission Assurance
OSFA	Office of Safety and Facility Assurance
OSHA	Occupational Safety and Health Administration
SDL	Standard Distribution List
SPL	Sound Pressure Level
TWA	Time-weighted average